

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

PROBLEMS OF PROGRESS IN INDUSTRY—7

THE OLDER WORKER AND HIS JOB

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PREFACE

The object of this series is to present briefly and simply the results of new research into the social, economic and technical problems of industrial progress—problems arising from automation and other advances in techniques, and problems of management and human relations. The booklets are either 'industrial versions' of academic reports that have been or soon will be published elsewhere; or short reviews of research done independently by several teams. The series is planned in the belief that responsible officials on both sides of industry feel the need to digest and use new research material but have not the time to browse through full-length volumes.

In issuing this series the Department of Scientific and Industrial Research seeks only to provide a forum for responsible new thinking and to stimulate independent discussion and action, including further research. The conclusions and speculations are those of the investigators, mostly from the universities and other well-known research bodies.

This issue is a review of recent research in the field of ageing, and has been prepared by the Department of Scientific and Industrial Research at the request of the Ministry of Labour. It is hoped that this knowledge of the changes that occur with increasing age will contribute towards the continued useful employment of older men and women. For it is in the social and economic interests of employers and society as a whole to make the fullest use possible of the experience and capabilities of older workers in a period of rapid technological development and industrial expansion.

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I. MATCHING JOB AND WORKER

This booklet aims at giving a brief account of some of the findings of recent research carried out in laboratory and in industry to investigate the physical and mental changes that occur from the twenties upwards, and an indication of their effects on the employment of older people.

Words like 'younger' and 'older' are not associated in themselves with any particular age, but derive their meaning only from the context in which they are used. Thus to the child all adults are older, while to the man in his eighties his friend of 70 is a mere youngster. There is, in fact, no natural dividing line between younger and older because ageing is a continuous process from birth to extreme old age. In this booklet, however, an arbitrary line will be drawn, so that 'older' refers to anyone aged 40 and over. This age has been chosen because research has shown that the effects of some of these changes on performance begin to become important by the forties. Moreover, 50 per cent of the total number of men in the employment field are over 40 years of age. Older workers, in this sense, are not therefore a minority group, but form half the total labour force available to industry.

It is obvious that a job can be done well only when its demands are within the capacity of the worker doing it. The initial match or balance between job and worker depends on the success of methods of specifying the requirements of the job, selecting the 'right' man for it and giving him adequate training. Standards for jobs are usually set for young men, and age limits for entry and training to most jobs mean that the 'right' man is usually the young recruit to industry. Although applicants who fail to reach the minimum requirements for a job are weeded out in the selection process, the possibility remains that changes of capacity with age will mean that, after a number of years, the balance between capacity and the demands of the job will no longer be maintained. On the other hand, the young recruit is a man of potentiality rather than of proven ability, and it may be that the experience a man or woman gains on a job over the years can more than offset any adverse change with age.

In the following sections research findings about the effects of changing capacity with age will be considered first where the

older worker continues to meet the demands of his job, and secondly where he experiences difficulty in doing so. Finally the problem of rematching the job and the worker will be discussed.

One finding that is common to almost all the studies is that there are wide differences between people in the age at which changes in capacities become important, and the extent to which they affect performance. Therefore, the older worker in this booklet must be considered that imaginary person—Mr. Average Man over 40—because what is known about him is based on statistical comparisons between groups of people of different ages.

II. HOW CAPACITY CHANGES WITH AGE

Increased knowledge of the job

In some high-grade skilled occupations it may take many years before a craftsman reaches his maximum standard of performance. It is commonly held that having done so, he is able to maintain this standard relatively well until at least the normal retiring age. This opinion was confirmed by a study of productivity for three skilled operations at two printing firms, where output tended to rise from the twenties to the forties and only showed a slight fall-off among men over 50.

The experience of the older man often enables him to get more out of a machine than a younger man who has not yet mastered the idiosyncracies of a particular machine or process, or who has not yet acquired the valuable 'tricks of the trade' that mark the experienced man.

The older worker is more accurate

Research findings suggest that where there is a choice between doing a job quickly but making mistakes, or doing it accurately but taking a longer time, the older man prefers to concentrate on producing accurate work.

Although he becomes slower, he is often able to compensate for loss of speed, for example by wasting less material in sub-standard products, and he may thus maintain a better output than a younger man who works more quickly but at the expense of accuracy.

Other assets in his favour

It is generally agreed that the older worker is responsible, reliable, conscientious and loyal.

Studies of factory records generally show a decline in labour turnover among older workers. For example, labour turnover in seventeen firms on Merseyside in 1957 was 32 per cent among men aged 25 to 39, and 11 per cent among those aged 40 and over. A study of about 1700 men who had left a light engineering firm over a period of 8 years, suggests that men who are taken on over 37 years of age will give longer service than those who are younger, and that fewer of them want to leave voluntarily.

Where the job demands knowledge, accuracy and stability the older worker compares favourably with the younger man.

Where the balance is upset

Evidence that the capacity of the older worker may no longer match the demands of his job, is seldom found in records of lowered output or decline in standards of work. Obvious inefficiency is unlikely to be tolerated for any length of time either by the employer or by the older man himself. Evidence of difficulty for older workers is to be seen, however, in the trend for men in middle and old age to drift away from direct production jobs to ancillary work in industry, or even to leave industry altogether.

For example, a survey showed that the proportion of older men tended to be high in managerial occupations (which would be expected because they were older) and in unskilled jobs, but was lower in semi-skilled jobs. Again, in seven engineering firms it was found that younger men were on the most exacting skilled jobs, such as borer, miller or grinder, while older men were doing less exacting work concerned with plating, heat treatment and storekeeping.

When older men voluntarily request to be moved off certain jobs it is often after they have been away from work because of illness or injury. For example, about 63 per cent of the men who moved to less heavy work in two foundries and a coal-mine did so on returning to work after illness. The decision to move is often the result of some suggestion from their family, or from people they work with, or perhaps from their doctor. Although they often

attribute their move to the illness which has precipitated it, the real cause commonly lies in the changes which have been taking place slowly over the years, and have resulted in their work becoming an increasing strain.

What are these changes and how do they affect performance?

Slowing up

A survey of 95 production operations in 24 firms made it clear that, among several factors studied, the most serious difficulty for older people came from demands for speed. The difficulty was especially severe when there was a rigid requirement to keep pace with fast acting machinery. The numbers of both men and women on jobs of this kind were high until the middle 40's but from the early 50's onwards there were practically none. A possible reason in some cases was that the jobs were new and, having been initially staffed by young entrants, the workers on them had not had time to grow old. This was not, however, the explanation in many cases and certainly not the main one overall. The essential reason was that practically all the people between 45-55 on these jobs were moving to other work. A typical comment came from men on a car assembly line where they complained of being 'kept on the go the whole time' and sought transfer to other jobs such as to rectification benches at the side of the line, where they could do similar work but at their own pace.

Studies of laboratory tasks specially designed to bring out one or another aspect of performance have shown that this slowness is not so much due to loss of speed in the actual making of muscular movements, as to slowness of making decisions and of relating what is seen to what has to be done. The extra time taken at any one point of the task may be small, so that it is not very obvious to an observer, but the total effect may be substantial.

There is some evidence from the laboratory that being able to look ahead to what is coming and plan the next move, may mitigate some of the difficulty older people experience on paced work. The reason seems to be partly that being able to look ahead makes the task easier because the broad outlines of what has to be done stand out among the details. Probably more important, however, is that it allows some flexibility in the timing of actions and thus reduces the rigidity of pacing.

Turning again to industry it seems that where it is impossible to reduce the speed of working, difficulty for older people may be lessened by introducing some degree of flexibility into the timing of the work, so that an older worker who is slow at one moment may take up the time in the next. Flexibility of this kind is one of the important advantages of the 'buffers' commonly found between positions on conveyor lines.

Pressure for speed may be set not only by machinery but by other members of a working team, and pressure by the younger members of a team working on group piece-rates may cause older members to move away from the job. An example of this was found in a study of stove-fitters, where the younger workers complained that the older ones could not keep pace with them, and were therefore hindering the earning capacity of the group as a whole.

Payment systems based solely on quantity may put older workers at a disadvantage even on jobs where the pace is more flexible and they can work individually. For example, men employed on perforating films had to move continuously between a number of machines, removing perforated films, reloading and restarting the machines. Although they could reduce the speed of work by allowing the machines to stand idle for a time, in practice they exerted every effort to keep their machines going all the time, so as to maintain their piece-rate earnings. It was found that older men moved away from this job. During a study of older men working in foundries, the iron-moulders were almost unanimous in saying that as age increases piece-work imposes greater strain.

The older worker may find it difficult to keep up with the demands for speed, whether these are made by the machine he operates, or by the team he works with, or by a payment system.

Heavy muscular work

In general the results of investigations into physical changes with age reveal that maximum muscular strength and speed of recovery from exertion reach a peak in the 20's and 30's, and decline gradually in the 50's and 60's. This would seem to confirm a common assumption that heavy physical work is unsuitable for

older workers. Yet a study of the 1951 Census figures showed that a larger proportion of people between 45 and 60 were employed on heavy labouring jobs than on lighter operations. When interviewed some of these older men said they found their work a strain, but evidently not so much of one that they felt forced to change.

The tendency for older men to be employed on the heavier jobs was strikingly illustrated in a firm manufacturing batteries, where men changed jobs periodically to reduce the risk of lead poisoning. The firm's time-study department graded the jobs according to the degree of physical exertion required. It was then found that practically all the very heavy work was being done by men over 50 and the light work by those under 50, even though they had frequent opportunities to change if they wished to do so.

It is not always clear what is meant by 'heavy' work, for what may be considered heavy in one industry may be light in another. Attempts have been made to identify what it is that makes some heavy work unsuitable for older men, by dividing heavy work into two types. One involves considerable muscular effort in handling, lifting and moving heavy objects. A high proportion of men between 45 and 60 were found, in one survey, on such jobs as the handling, stencilling and loading into lorries of paint drums, weighing about 42 lb, and of cases up to 120 lb, and feeding planks of 50 lb into sawing machines.

The other types of work regarded as heavy in the factories concerned involved *continuous bodily activity together with a fast rate of working*. It is this latter type which seems more unsuitable for older men. It was found, for example, that older men moved off tyre-casemaking operations where the heavy and very active work involved in assembling the components of large tyres before moulding was done under conditions which imposed pressure for speed. Again, in furniture making, men in their 50's tend to leave the job of pulling-over in the polishing shop, which is considered suitable only for younger active men.

The difficulty caused by this second type of heavy work seems to be due to the fact that both exertion and speed tend to affect older people adversely, and when they are combined the demand is very severe. The important point to note is that although very strenuous and unremitting muscular work is difficult for older people, frequent brief rests make quite severe muscular effort

possible at least by those who are 'in training'. The more stringent limit upon older people is the demand for speed. This was well illustrated in a study of 489 men aged 50 or over employed in two foundries and a coal-mine. It was found that 60 per cent had moved to so-called 'lighter' work. For many of the men this had meant a reduction in the skill of their jobs. When asked what they meant by 'lighter' work, the majority replied that they meant work in which they were able to regulate the pace.

An important implication from this is that transfer from strenuous heavy work should be to lighter work which does *not* impose pressure for speed.

Moves away from over-demanding work may be made in two or more stages. The first 'retirement', as one research worker has called it, may be as early as the forties, and others at intervals up to the final retirement. It is an interesting illustration of the relationship between demand for muscular effort and for speed that moves are sometimes seen in the forties and fifties away from fast work to jobs which in terms of muscular effort are actually heavier.

Provided he is not debarred from heavy physical work on medical grounds, the older worker finds its demands less exacting than those made by lighter work involving pressure for speed.

Changes in vision

Where the job requires close visual attention, eyesight failing with age may make work difficult for older people.

The laboratory evidence on this point is clear and shows that fine visual tasks are much more difficult for older people than the usual tests of eyesight would lead one to suppose. An experiment is worth quoting here. People, whose ages range from 20 to 45, were given sheets of paper on which were printed a number of broken rings. They were instructed to cancel with a pencil each ring having the break in a certain direction. In spite of the fact that all had been matched for eyesight and were able to read visual test charts (wearing glasses where necessary), there was a fall with age in the number of rings correctly cancelled in a given time. This fall was especially severe when the illumination was

poor, or the rings were very small, or contrasted poorly against the paper on which they were printed. Higher levels of illumination brought the scores of different ages closer together but still did not make those of older and younger equal.

However, good lighting conditions may enable a man to continue a job requiring fine visual control which he could not do under the conditions often found at work. The level needs to be high, with care taken in the positioning of light sources to avoid glare and shadows, giving a good general illumination with some extra emphasis on the work-place.¹

The difficulty the older people have with fine visual tasks may lead to slowness or to errors or to a mixture of both. The implications for inspection work are obvious, although it may be, in part at least, offset by the understanding of what to look for that comes with long experience of a particular product or type of article.

Other physical changes

Several other types of physical change may affect a man's or woman's working capacity, but cannot be fully discussed here. Some, such as the loss of hearing, especially of sensitivity to high tones, are well known.

Some older people lose the capacity for fine muscular control and thus become unsuitable for delicate assembly jobs or for making fine adjustments to very light controls.

More widespread, probably, are difficulties due to older people becoming less resistant to stress from factors such as intense heat, or to fatigue. For example, fatigue due to awkward working posture may affect an older worker's ability to continue on certain jobs. It was found in a study of some engineering firms, that there were fewer older men on jobs where operators had to spend most of their time stooping at an angle of about 30° or more from the vertical.

It should be borne in mind that some of the fatigue affecting an older person's capacity may arise outside the job itself. An example of this was shown among older coal miners who stripped coal at their own speed without any visible signs of stress. However, they had to walk up a hill to the pit and then a

¹The attention of the reader is drawn to an article by R. G. Hopkinson and J. Longmore 'Attention and distraction in the lighting of work-places', *Ergonomics*, 1959, 2(4).

mile from the pit-bottom to the coal-face fast enough to keep up with the younger men in the group. The men in their 50's found this walk sufficiently taxing for them to request transfer to lighter work.

Forgetfulness

Well-established memories seem to remain clear as people get older, but retention for a short time of what has just been observed often suffers. This loss of short-term memory is well-known in extreme old age, but seems to begin in a subtle way much earlier.

The laboratory studies serve to refine and qualify common observation. It is not just any short-term retention that becomes difficult for older people. Men and women in their 60's have been shown to be able to repeat back a string of digits spoken to them almost as accurately as can those in their 20's. The main difficulty arises when older people have to remember something while doing something else—situations like those when a man looks up a telephone number, then when he has found the letter on his desk to which he wants to refer and is ready to dial the number, finds he has forgotten it. In a laboratory task imposing this sort of demand the fall of retention between the 20's and the 60's was very great. It seems as if the intervening activity, such as finding the letter, breaks up the memory 'trace'.

This kind of short-term memory loss seems to result also from factors other than age. Apart from certain clinical conditions the most interesting is fatigue—as shown by studies of civilian aircrew before and after flight. From the point of view of older people it has widespread repercussions not only for the straightforward retention of facts, but because it limits ability to solve certain kinds of problems. In several laboratory problems, just as in many problems of real-life and many of the puzzles set as games, a person is required to gather data then hold it while gathering more in order to combine them together. An older person tends to find that unless he writes down or otherwise records the first set of data, he has lost it by the time he has obtained the second set. The result is back-tracking and confusion which leads, in cases where difficulty is not serious, to slowness, and in more severe cases, to the person throwing in his hand or producing a solution which is patently not based on all the facts.

The difficulties resulting from impairment of short-term memory are obvious for those in managerial positions, but are also important in many shop-floor tasks. In order to supervise a group of men or to service a number of machines, a man will have to 'keep tabs on' many developing situations over a wide area: he will not be able actually to see them all at once and will be forced to rely in part on memory. Again many process monitors, such as in chemical plants, have to make adjustments to their controls, the effects of which are delayed for periods of many minutes. If they do not remember accurately what adjustments they have made, later corrective action may be chaotic.

Relating what is seen to what is done

When an object is manipulated directly by hand, or when simple hand tools are used the actions taken bear a very straightforward and direct relationship to what is seen. On many machine tools, however, the direction and force of controlling movements do not correspond directly to what is seen or to the effects they produce, for example, a circular motion of the hand is usually required to drive a tool carrier from side to side on a lathe. The confusing nature of a gear-box for a learner car-driver is well known.

Complications between what is seen and what is done appear to place older people at a disadvantage. A simple example is doing all except the most familiar actions in a mirror. These and more elaborate complications incorporated in laboratory experiments indicate that while mild degrees of complication cause relatively little deterioration of performance among older people, the effect in relation to age of more severe degrees is quite disproportionate.

The research findings have three important implications. Firstly, if mechanical aids are to be used easily by older workers there should be a consistent relationship between what the operator sees and the action he has to take, based on principles which can be transferred from one machine to another. Secondly, installations of mechanical aids and transfers of workers from heavy work need to be made with caution: the new job may impose a mental load far more severe than the physical load it has removed. Thirdly, however, relatively small modifications to complex jobs at present impracticable for older people, might bring these jobs within their capabilities.

Changes in mental ability that are found as one grows older reduce a worker's efficiency at jobs where he has to remember information for a short time before he makes use of it, or where he has to translate or alter the information in some way mentally before he can take the appropriate action.

Accidents

The credit and debit sides of age are both illustrated in the trends of accidents incurred by younger and older workers. The general impression given by a number of studies is that there are fewer accidents among older workers. Several factors contribute to this lower rate. For example, lack of experience is largely responsible for the high rate of accidents among younger workers in their first few months at a job. The longer a man is on a job the more likely he is able to anticipate and possibly avoid conditions leading to accidents and also to know what action to take in an emergency.

At the same time studies of absence records have shown that although older workers have fewer accidents than younger, they take longer to recover from them, and the time lost through accidents increases with age. Similarly, older workers are absent less often because of illness, but are away for a longer period each time, and thus may lose a greater number of days each year than younger workers.

In general, young people tend to have accidents connected with the job they are doing, such as mishaps with tools and machines, resulting in injury to those parts of the body directly concerned with the job. Provided that an older man is doing a job well within his physical and mental capacities, his wider experience and greater accuracy make him less liable to accidents of this kind. Where he finds difficulty in meeting the normal demands of his job, he is unlikely to be able to cope in an emergency and is thus more liable to accidents. A study of accidents occurring over four years in a large factory manufacturing piston and turbo-prop aero engines, showed that older workers were particularly liable to accidents on jobs such as those of electrician, miller, and grinder, on which the majority of workers were young men.

Older people are more liable to falls and to being struck by falling or moving objects. Their injuries are more often to parts of the body not directly involved in normal work activity. For this reason slippery floors, the use of raised surfaces, and ladders are a greater potential danger to older than to younger workers.

The main cause of such accidents to older people seems to be slowness either in recovery when thrown off balance or in getting out of the way of moving objects, especially those which appear suddenly. For example, older people are often involved in road accidents because, having made up their minds to cross a road they are unable to change their minds quickly enough to avoid, say, a car which appears suddenly from behind a stationary vehicle.

Deteriorating eye-sight may cause accidents on jobs where a clear and rapid vision of the movement of a machine is essential. Temperature conditions too may affect older workers more than younger. For example, it was found that coal miners over 35 years of age were more liable to accidents than those under 35, when they were working in temperatures about 70° but were less liable in lower temperatures.

High incidence of accidents on certain jobs should not be a reason for not employing older workers on those jobs, but rather should stimulate investigation into ways of modifying the job to reduce its demands, and of providing safety devices, of removing potential hazards, of improving lighting and other environmental conditions, thus reducing the risk of accidents not only to older but also to younger workers.

III. MATCHING JOB AND WORKER ANEW

There are two ways of solving the problem of the older worker whose performance begins to decline or who comes to find his work an undue strain.

Modify the job

The research surveyed in this booklet suggests clearly that the introduction of even slight modifications could often enable the

small frames using thick elastic instead of thread. Once the weaves were mastered, they were able to transfer to normal cloth. The fact that the trainees constructed the weaves themselves meant they were not dependent upon verbal descriptions or memorising. The net result was that the older trainees (aged 30-50) learnt *much faster* than school leavers.

IV. NEED FOR MORE FACTS

A number of studies have revealed some of the changes that occur with age, indicating how they may affect behaviour and have laid the basis for future developments in the study of ageing, but a great deal more needs to be known before the problem of making the fullest use of an ageing labour force can be solved. For example, there are some general characteristics of work that are unsuitable for older people, but much detailed study needs to be done before routine methods can be formulated for modifying work to suit older people. Again, it is known that older people find it easier to learn some jobs than others, and take training by some methods more readily than they do by others. The study of training in relation to age is still, however, undeveloped and it seems likely that if more attention were given to it, important results would emerge. Changing jobs raises problems of adjustment to new conditions, and of acceptance of altered status. Practically nothing is known of how to mitigate these problems and help older people to meet them.

It is pertinent to ask whether some of the less desirable changes with age are more matters of attitude and habit than of capacity, and thus whether the interests and spare-time activities of the over-40's, which can balance life and reduce its strains and tensions, are associated in any way with the continuance of working efficiency. Up to now, the information has been on the side of what jobs are unsuitable for the older worker, rather than pointing out those which he can do best.

Much more detailed laboratory work is still needed, but the stage has now been reached when research must be extended from the laboratory to the shop floor. A start has been made. The

Unit for Research on the Employment of Older Workers, at Bristol University, is investigating, particularly in the engineering industry, the nature and complexity of skilled jobs, the factors that cause difficulty, and how performance starts to break down. They are also interested in what happens to older workers who can no longer cope with the demands of their jobs, and in the opportunities open to them for retraining. The Medical Research Council Group for Research into the Occupational Aspects of Ageing, at Liverpool University, is studying changes of vision, hearing, learning ability, and attitude during adult life, with particular reference to those likely to be of occupational importance. It is also investigating methods of preparation for retirement.

The work calls for close and continued co-operation between, on the one hand, research workers attached to universities and in touch with the fundamental human sciences and, on the other, all levels of industry. Co-operation between scientists and industry has proved fruitful in many fields. The indications are clear that it has an essential contribution to make in the solution of 'problems of ageing'.

FURTHER READING

This booklet is based largely on '*Ageing and Human Skill*' by A. T. Welford (Oxford University Press for the Nuffield Foundation, 1958), and has been approved by the author. This book is centred on the work of the Nuffield Unit for Research into Problems of Ageing which was attached to the University of Cambridge from 1946-1956. Reference is, however, made to relevant research done elsewhere.

The following articles on problems of employment of older workers are also recommended.

Types of work

BELBIN, R. M. 'Older people and heavy work', *British Journal of Industrial Medicine*, 1955, Volume 12.

GRIEW, S. and TUCKER, W. A. 'The identification of job activities associated with age differences in the engineering industry', *Journal of Applied Psychology*, 1958, Volume 42.

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